SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR

(AUTONOMOUS)

M.Tech. (Electronics and Communication Engineering)

Specialization: Digital Electronics & Communication Systems

I M.Tech - I Sem

S.No	Course Code	Course Name	L	T	P	Credits
1	19HS0823	Research Methodology and IPR	2	-	-	2
2	19EC4001	Advanced Digital System Design	3	-	-	3
3	19EC4002	Advanced Digital Signal Processing	3	-	-	3
4	**Programme Elective – I**					
	19EC4003	Antenna and Radiating Systems	3	-	-	3
	19EC4004	Digital Communication Techniques				
	19EC4005	DSP Processors & Architectures				
5	**Programme Elective –II**					
	19EC4006	High Speed Networks	3	-	-	3
	19EC4007	Voice and Data Networks				
	19EC4008	Wireless Sensor Networks				
6	19EC4009	Advanced Digital Signal Processing Lab(Virtual Lab)	-	-	4	2
7	19EC4010	Advanced Digital System Design Lab	-	-	4	2
Audit Course – I						
8	19HS0818	English for Research Paper Writing	2	-	-	-
Contact Periods / Week			16	-	8	18
			Total/Week: 24			

I M.Tech – II Sem

S.No	Course Code	Course Name	L	T	P	Credits
1	19EC4011	Wireless Communications	3	-	-	3
2	19EC4012	Coding Theory & Techniques	3	-	-	3
3	**Programme Elective – III**					
	19EC4109	Introduction to IoT	3	-	-	3
	19EC4013	Adaptive Signal Processing				
	19EC4014	Cognitive Radio				
4	**Programme Elective – IV**					
	19EC4015	Image & Video Processing	3	-	-	3
	19EC4016	Pattern Recognition and Machine learning				
	19EC4017	Detection & Estimation of Signals				
5	19EC4018	Advanced Communications Lab	-	-	4	2
6	19EC4019	Image & Video Processing Lab	-	-	4	2
7	19EC4020	Mini Project	-	-	4	2
Audit Course – II						
8	19HS0829	Constitution of India	2	-	-	-
Contact Periods / Week			14	-	12	18
			Total/Week: 26			

II M.Tech - I Sem

S.No	Course Code	Course Name	L	T	P	Credits
Programme Elective - V						
1	19EC4021	Optical Networks	3	-	-	3
	19EC4213	Testing & Testability				
	19EC4022	RF and Microwave Circuit Design				
Open Elective						
2	19HS0824	Business Analytics	3	-	-	3
	19CE1028	Cost Management of Engineering Projects				
	19EE2128	Waste to Energy				
	19ME3121	Industrial Safety				
	19ME3021	Advances in Operations Research				
	19ME3022	Composite Materials				
3	19EC4023	DissertationPhase-I	-	-	20	10
Contact periods / Week			6	-	20	16
			Total/Week:26			

II M.Tech - II Sem

S.No	Course Code	Course Name	L	T	P	Credits
1	19EC4024	Dissertation Phase- II	-	-	32	16
Contact periods / Week			Total/Week:32			16

NOTE: L- Lecture, T- Theory, P-Practical

LIST OF SUBJECTS

S.No	Course Code	Course Name
1.	19EC4001	Advanced Digital System Design
2.	19EC4002	Advanced Digital Signal Processing
3.	19EC4003	Antenna and Radiating Systems
4.	19EC4004	Digital Communication Techniques
5.	19EC4005	DSP Processors & Architectures
6.	19EC4006	High Speed Networks
7.	19EC4007	Voice and Data Networks
8.	19EC4008	Wireless Sensor Networks
9.	19EC4009	Advanced Digital Signal Processing Lab (Virtual Lab)
10.	19EC4010	Advanced Digital System Design Lab
11.	19HS0823	Research Methodology and IPR
12.	19HS0818	English for Research Paper Writing
13.	19CE1029	Disaster Management
14.	19HS0825	Sanskrit for Technical Knowledge
15.	19HS0826	Value Education
16.	19EC4011	Wireless Communications
17.	19EC4012	Coding Theory & Techniques
18.	19EC4109	Introduction to IOT
19.	19EC4013	Adaptive Signal Processing
20.	19EC4014	Cognitive Radio
21.	19EC4015	Image & Video Processing
22.	19EC4016	Pattern Recognition and Machine learning
23.	19EC4017	Detection & Estimation of Signals
24.	19EC4018	Advanced Communications Lab (Virtual Lab)
25.	19EC4019	Image & Video Processing Lab
26.	19EC4020	Mini Project
27.	19HS0829	Constitution of India
28.	19HS0827	Pedagogy Studies
29.	19HS0828	Stress Management by Yoga
30.	19HS0819	Personality Development through Life Enlightenment Skills.
31.	19EC4021	Optical Networks
32.	19EC4213	Testing & Testability
33.	19EC4022	RF and Microwave Circuit Design
34.	19HS0824	Business Analytics
35.	19CE1028	Cost Management of Engineering Projects
36.	19EE2128	Waste to Energy
37.	19ME3121	Industrial Safety
38.	19ME3021	Advances in Operations Research
39.	19ME3022	Composite Materials
40.	19EC4023	Dissertation Phase-I
41.	19EC4024	Dissertation Phase -II

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I M. Tech. – I Sem.

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(19HS0823) RESEARCH METHODOLOGY AND IPR

COURSE OBJECTIVES
The objectives of this course:

1. *Understand some basic concepts of research and its methodologies*
2. *Identify appropriate research topics*
3. *Enrich knowledge to their research field*
4. *Process for filing Patent*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *Recognize appropriate research problem, errors in selecting a research problem, Scope and objectives of research*
2. *Critically assess research methods pertinent to technology innovation research*
3. *Identify, explain, compare, and prepare the key elements of a research proposal/report*
4. *Skill to understand the need of intellectual property rights, IPR protection to inventors*
5. *Develop procedural knowledge to Legal System and solving the problem relating to intellectual property rights for further research work and investment in R & D*

UNIT – I
Research: Meaning of research problem - Sources of research problem - Criteria - Characteristics of a good research problem - Errors in selecting a research problem - Scope and objectives of research problem - Approaches of investigation of solutions for research problem - data collection, analysis, interpretation - Necessary instrumentations.

UNIT – II
Literature survey in Research: Effective literature studies approaches - analysis - Plagiarism - Research ethics.

UNIT – III
Project Report: Effective technical writing - how to write report – Paper - Developing a Research Proposal - Format of research proposal -A presentation and assessment by a review committee.

UNIT – IV
Intellectual Property Rights: Nature of Intellectual Property – Patents, Designs, Trade and Copyrights - Process of Patenting and Development - Technological research, innovation, patenting, development - International Scenario - International cooperation on Intellectual Property - Procedure for grants of patents - Patenting under PCT

UNIT – V

Patent Rights: Scope of Patent Rights - Licensing and transfer of technology –Patentinformation and databases - Geographical Indications - New Developments in IPR - Administration of Patent System - New developments inIPR - IPR of Biological Systems, Computer Software - Traditional knowledge, Case Studies - IPR and IITs.

TEXTBOOKS

1. CR Kothari, "*Research Methodology: Methods and Techniques*" 3rd Edition, New Age International (P) Limited, Publishers, 2013.
2. NeerajPandey & Khushdeep Dharani, "*Intellectual Property Rights*" Eastern Economy Edition, PHI Learning Private Limited.

REFERENCES

1. John W. Creswell, "Research Design – Qualitative, Quantitative and Mixed Methods Approaches",SAGE Publications, New Delhi, 4th Edition, 2014.
2. RanjitKumar,"*Research Methodology: A Step by Step Guide for beginners*" SAGE Publications, New Delhi,4thEdition, 2014.
3. Ramakrishna B & Anil Kumar H.S "*Fundamentals of Intellectual Property Rights- for students, Industrialist and Patent Lawyers*", First Published, Notion Press, Chennai, 2017.
4. Ahuja VK, "*Intellectual Property Rights in India*", Mittal Books India, 2nd Edition, 2015.
5. KC Kankanala, AK Narasani & V Radhakrishnan, "*Indian Patent Law and Practice*", Oxford India Paperbacks,2012.

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(19EC4001) ADVANCED DIGITAL SYSTEM DESIGN

COURSE OBJECTIVES
The objectives of this course:

1. *To introduce methods to analyze and design synchronous and asynchronous sequential circuits.*
2. *To introduce the architectures of programmable devices.*
3. *To test the performance of digital circuits by various algorithms.*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *Knowledge of digital integrated circuit hardware design.*
2. *Analyze and design combinational and sequential digital circuits.*
3. *Identify the requirements and specifications of the system required for a given application.*
4. *Able to learn the benefits and drawbacks of various design methods.*
5. *Test the performance of combinational and sequential digital circuits.*

UNIT – I
Design of Digital Systems: ASM Charts –Hardware Description Language And Control Sequence Method – Reduction of State Tables, State Assignments.
Sequential Circuit Design: Design of Iterative Circuits – Design of Sequential Circuits Using Roms, PLAs, CPLD And FPGAs.

UNIT – II
Fault Modeling: Fault classes and models – Stuck at faults, bridging faults, Transition and Intermittent faults.
Test Generation: Fault diagnosis of Combinational circuits by conventional methods – Path Sensitization technique, Boolean difference method, Kohavi algorithm.

UNIT – III
Test Pattern Generation: D – Algorithm, PODEM, Random testing, Transition count testing, Signature Analysis and Testing for bridging faults.

UNIT – IV
Programming Logic Arrays: Introduction – Design using PLA's, PLA minimization and PLA folding.
Fault Diagnosis in Sequential Circuits: State identification and Fault detection experiment - Machine identification, Design of fault detection experiment.

UNIT – V
PLA Testing: Fault models – Test generation and Testable PLA design.
Asynchronous Sequential Machine: Fundamental mode model – Flow table, State reduction, Minimal closed covers, Races, Cycles and Hazards.

TEXTBOOKS

1. Z. Kohavi, (TMH), *Switching & finite Automata Theory*, 2004.
2. M.Abramovici, M.A. Breues, A. D. Friedman, *Digital System Testing and Testable Design*, JaicoPublications, 2004.

REFERENCES

1. M.MorrisMano, *Digital Design*, Pearson Education 3rd Edition, 2005.
2. Charles H. Roth Jr , *Fundamentals of Logic Design,* 5th Edition, 2004.
3. Frederick. J. Hill & Peterson, Wiley, Computer *Aided Logic Design,* 4th Edition, 2005.
4. N.N.Biswas (PHI), *Logic Design Theory*, 2006.
5. Nolman Balabanian, Bradley Calson Wiley, *Digital Logic Design Principles*, Student Edition,2004.

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(19EC4002) ADVANCED DIGITAL SIGNAL PROCESSING

COURSE OBJECTIVES

The objectives of this course:

1. *Comprehend mathematical description and modeling of discrete time random signals.*
2. *Familiar with important theorems and algorithms of Digital Signal Processing.*
3. *Understand the concepts of estimation, prediction and filtering concepts and techniques.*

COURSE OUTCOMES (COs)

On successful completion of course, the student will be able to

1. *Know the analysis of discrete time signals.*
2. *To study the modern digital signal processing algorithms and applications.*
3. *Have an in-depth knowledge of use of digital systems in real time applications.*
4. *Apply the algorithms for wide area of recent applications in digital signal processing.*
5. *To study the modern filter design and implementation.*

UNIT – I

Overview: Discrete-Time Signals, Sequences and Sequence Representation – Discrete-Time Systems– Time-Domain Characterization and Classification of LTI Discrete-Time Systems– The Continuous-Time Fourier Transform– The Discrete-Time Fourier Transform– Energy Density Spectrum of a Discrete-Time Sequence– Band-Limited Discrete-Time signals– The Frequency Response of LTI Discrete-Time System.

LTI Systems: Types of Linear-Phase Transfer Functions– Simple Digital Filters– Complementary Transfer Function– Inverse Systems– System Identification– Digital Two-Pairs– and Algebraic Stability Test.

UNIT – II

Digital Filter Structure and Design: All Pass Filters – Tunable IIR Digital Filter, IIR Tapped Cascade Lattice Structures – FIR Cascaded Lattice Structures – Parallel All Pass Realization of IIR Transfer Functions – State Space Structures – Polyphase Structures – Digital Sine-Cosine Generator – Computational Complexity of Digital Filter Structures – Design of IIR Filter using pade approximation – Least Square Design Methods – Design of Computationally Efficient FIR Filters.

UNIT – III

FFT Algorithms: Fast DFT Algorithms Based on Index Mapping – Sliding Discrete Fourier Transform – DFT Computation Over a Narrow Frequency Band – Split Radix FFT – Linear Filtering Approach to Computation of DFT using Chirp Z-Transform.

Multi Rate Signal Processing: Decimation by a Factor D – Interpolation by a Factor I – Sampling Rate Conversion by a Rational Factor I/D – Filter Design & Implementation for Sampling Rate Conversion.

UNIT – IV

Power Spectral Estimation: Estimation of Spectra from Finite Duration Observation of Signals – Non-Parametric Methods: Bartlett, Welch & Blackman & Tukey methods.

Parametric Methods for Power Spectrum Estimation: Relation Between auto Correlation & Model Parameters– Yule-Walker& Burg Methods – MA & ARMA Models for Power Spectrum Estimation.

UNIT – V

Analysis of Finite Word length Effects in Fixed-Point DSP Systems: Fixed, Floating Point Arithmetic – ADC Quantization Noise & Signal Quality-Finite Word Length Effect in IIR Digital Filters – Finite Word-Length Effects in FFT Algorithms.

Applications of Digital Signal Processing: Dual Tone Multi-Frequency Signal Detection, Spectral Analysis of Sinusoidal Signals, Spectral Analysis of Non- stationary Signals, Musial Sound Processing, Over Sampling A/D Converter, Over Sampling D/A Converter, Discrete-Time Analytic Signal Generation.

TEXTBOOKS

1. Sanjit K Mitra, *Digital Signal Processing,* Tata McGraw Hill Publications.
2. J. G.Proakis, D. G.Manolokis, *Digital Signal Processing Principles Algorithms, Applications,*PHI.

REFERENCES

1. A. V.Oppenhiem, R. W. Schafer, *Discrete-Time Signal Processing,* Pearson Education.
2. Emmanuel C Ifeacher Barrie. W. Jervis, *DSP- A Practical Approach*, Pearson Education.
3. S. M. Kay, *Modern spectral Estimation techniques,*PHI,1997.

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I M. Tech. – I Sem.	**L**	**T**	**P**	**C**
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(19EC4003) ANTENNA and RADIATING SYSTEMS
(Programme Elective –I)

COURSE OBJECTIVES
The objectives of this course:

1. *Fundamentals of Electromagnetic Radiation, Poynting's Theorem.*
2. *Fundamentals of Antenna, Parameters of Antenna, Various Types of Antennas and Applications.*
3. *Design of antenna arrays, broadside and end fire arrays, array synthesis, coupling effects and mutual impedance, parasitic elements.*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *Understanding the Basic Principles and Radiation of Antennas.*
2. *Recognizing Fundamental Parameters of Antennas.*
3. *Explain Dipole Antennas, Establish Mathematical Equations for Various Parameters of thin Linear Antenna.*
4. *Understanding the Various Types of Antenna Arrays.*
5. *Design Wire Antennas, Loop Antennas, Reflector Antennas, Lens Antennas, Horn Antennas and Micro Strip Antennas.*

UNIT–I

Antenna Fundamentals: Types of Antennas, Wire Antennas, Aperture Antennas, Micro Strip Antennas, Array Antennas Reflector Antennas, Lens Antennas–Radiation Mechanism, 3 Current Distribution on Thin Wire Antenna–Fundamental Parameters of Antennas, Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna Efficiency, Beam Efficiency, Bandwidth, Polarization, Input Impedance, Radiation Efficiency, Antenna Vector Effective Length, Friis Transmission Equation, Antenna Temperature.

UNIT– II

Linear Wire And Loop Antennas: Linear Wire Antennas, Infinitesimal Dipole, Small Dipole, Region Separation, Finite Length Dipole, Half Wave Dipole, Ground Effects–Loop Antennas, Small Circular Loop, Circular Loop of Constant Current, Circular Loop With Non-Uniform Current.

UNIT– III

Linear Arrays: Two Element Array, N- Element Array, Uniform Amplitude and Spacing, Broadside and End Fire Array, Super Directivity, Planar Array, Design Consideration.

UNIT– IV

Aperture Antennas and Horn Antennas: Aperture Antennas, Huygen's Field Equivalence Principle, Radiation Equations, Rectangular Aperture, Circular Aperture– Horn Antennas, E-Plane & H-Plane Sectoral Horns, Pyramidal Horns, Conical Horns.

UNIT –V

Microstrip Antennas And Reflector Antennas: Micro Strip Antennas, Basic Characteristics, Feeding Mechanisms, Method of Analysis, Rectangular Patch, Circular Patch–Reflector Antennas, Plane Reflector, Parabolic Reflector, Cassegrain Reflectors– Introduction toMIMO.

TEXT BOOKS

1. Constantine A. Balanis, John Wiley & Sons,*Antenna Theory Analysis and Design*,4th Edition, 2016.
2. John D Kraus, Ronald J Marhefka, Ahmad S Khan,*Antennas for All Applications*,Tata McGraw-Hill,2002.

REFERENCES

1. R.C.Johnson and H.Jasik, *Antenna Engineering hand book*, Mc-Graw Hill,1984.
2. I.J.Bhal and P.Bhartia,*Micro-strip antennas*, Publisher,Artech house,1980.
3. K.D. Prasad, SatyaPrakashan,*Antennas and Wave Propagation,* Tech. India Publications, New Delhi, 2001.
4. E.C. Jordan and K.G. Balmain,Electromagnetic Waves and Radiating Systems, PHI, 2nd Edition, 2000.

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I M. Tech. – I Sem.

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(19EC4004) DIGITAL COMMUNICATION TECHNIQUES
(Programme Elective –I)

COURSE OBJECTIVES
The objectives of this course:

1. *To understand the building blocks of digital communication system.*
2. *To prepare mathematical background for communication signal analysis.*
3. *To understand and analyze the signal flow in a digital communication system.*
4. *To analyze error performance of a digital communication system in presence of noise and other interferences.*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *Analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.*
2. *Perform the time and frequency domain analysis of the signals in a digital communication system.*
3. *Select the blocks in a design of digital communication system.*
4. *Analyze Performance of spread spectrum communication system.*
5. *Analyze Performance of OFDM communication system.*

UNIT – I

Review of Random Variables and Processes: Random Variable – Moment Generating Function – Markov's Inequality – Chebyshev's Inequality – Central Limit Theorem– Chi-Square, Rayleigh, and Ricean Distributions – Correlation – Covariance Matrix Stationary Processes – Wide Sense Stationary Processes – Ergodic Process – Cross Correlation – Autocorrelation Functions – Gaussian Process.

Characterization of Communication Signals and Systems: Signal Space Representations-Vector Space Concepts, Signal Space Concepts, Orthogonal Expansion of Signals. Representation of Digitally Modulated Signals-Memory Less Modulation Methods.

UNIT – II

Communication Over Additive Gaussian Noise Channels: Optimum Receiver for Signals Corrupted by Additive White Gaussian Noise (AWGN)- Cross Correlation Demodulation, Matched Filter Demodulator and Error Probabilities, Optimum Receiver for Signals with Random Phase in AWGN Channels, Optimum Receiver for Binary Signals, Optimum Receiver for M-Array Orthogonal Signals, Probability of Error for Envelope Detection of M-Array Orthogonal Signals. Optimum Waveform Receiver for Colored Gaussian Noise Channels, Karhunen-Loeve Expansion Approach, and Whitening.

UNIT – III

Fading Channels: Characterization of Fading Multipath Channels, Statistical Models for Fading Channels, Time Varying Channel Impulse Response, Narrow and Wide Band Fading Models, Channel Correlation Functions, Key Multipath Parameters, Rayleigh And Ricean Fading Channels, Simulation Methodology of Fading Channels.

UNIT – IV

Digital Communication Over Fading Channels: Optimum Coherent and Non-Coherent Receiver in Random Amplitude, Random Phase Channels- Performance of Rayleigh and Ricean Channels, Performance of Digital Modulation Schemes Such as BPSK, QPSK, FSK, DPSK, MSK etc. Over Wireless Channels.

UNIT – V

Communication Over Band Limited Channels: Communication over Band Limited Channels- Optimum Pulse Shaping- Nyquist Criterion for Zero ISI, Partial Response Signaling- Equalization Techniques, Zero Forcing Linear Equalization- Decision Feedback Equalization.

Orthogonal Frequency Division Multiplexing (OFDM): Carrier Synchronization, Timing Synchronization, Multichannel and Multicarrier Systems.

TEXT BOOKS

1. J. Proakis, *Digital Communications*,McGraw Hill,2000.
2. J. Viterbi and J. K. Omura, *Principles of Digital Communications and Coding*, McGraw Hill, 1979.

REFERENCES

1. Marvin K. Simon, Jim K Omura, Robert A. Scholtz, Barry K. Levit *Spread Spectrum Communications*, 1995.
2. Andrew J Viterbi, Addison Wesley, *CDMA Principles of Spread Spectrum Communications*, 1995.
3. Ahmad R S Bahai, Burton R Saltzberg Mustafa Ergen, *Multi-carrier Digital Communications Theory and Applications of OFDM*, Springer Publications.
4. J.S. Chitode, *Digital Communication*, Technical Publications.
5. Edward. A. Lee and David. G. Messerschmitt, *Digital Communication*, 2/e, Allied Publishers.

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(19EC4005) DSP PROCESSORS & ARCHITECTURES
(Programme Elective –I)

COURSE OBJECTIVES
The objectives of this course:

1. *To recall digital transform techniques.*
2. *To introduce architectural features of programmable DSP Processors of TI and Analog Devices.*
3. *To give practical examples of DSP Processor architectures for better understanding.*
4. *To develop the programming knowledge using Instruction set of DSP Processors.*
5. *To understand interfacing techniques to memory and I/O devices.*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *Understand the basics of Digital Signal Processing and transforms.*
2. *Able to distinguish between the architectural features of General purpose processors and DSP processors.*
3. *Understand the architectures of TMS320C54xx devices.*
4. *Able to write simple assembly language programs using instruction set of TMS320C54xx knowledge.*
5. *Can Interface various devices to DSP Processors.*

UNIT – I

Introduction to Digital Signal Processing: Introduction, A Digital Signal-Processing System, the Sampling Process, Discrete Time Sequences – Discrete Fourier Transform (DFT)– Fast Fourier Transform (FFT)– Linear Time-Invariant Systems – Digital Filters – Decimation and Interpolation – Analysis and Design tool for DSP Systems MATLAB, DSP Using MATLAB.

Computational Accuracy in DSP Implementations: Number Formats for Signals and Coefficients in DSP Systems – Dynamic Range and Precision – Sources of Error in DSP Implementations, A/D Conversion Errors, DSP Computational Errors, D/A Conversion Errors, Compensating Filter.

UNIT – II

Architectures for Programmable DSP Devices: Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External Interfacing.

Execution Control and Pipelining: Hardware Looping, Interrupts, Stacks, Relative Branch Support Pipelining and Performance, Pipeline Depth, Interlocking, Branching Effects, Interrupt Effects, Pipeline Programming Models.

UNIT – III

Programmable Digital Signal Processors: Commercial Digital Signal Processing Devices, Data Addressing Modes of TMS320C54XX DSPs, Data Addressing Modes of TMS320C54XX Processors, Memory Space of TMS320C54XX Processors, Program Control, TMS320C54XX Instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX Processors, Pipeline Operation of TMS320C54XX Processors.

UNIT – IV

Implementation of Basic DSP Algorithms: The Q-notation, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, PID Controller, Adaptive Filters, 2-D Signal Processing.

Implementation of FFT Algorithms: An FFT Algorithm for DFT Computation, A Butterfly Computation, Overflow and Scaling, Bit-Reversed Index Generation, An 8-Point FFT Implementation on the TMS320C54XX, Computation of the Signal Spectrum.

UNIT – V

Interfacing Memory and I/O Peripherals to Programmable DSP Devices: Memory Space Organization, External Bus Interfacing Signals, Memory Interface – Parallel I/O Interface, Programmed I/O, Interrupts and I/O, Direct Memory Access (DMA). A Multichannel Buffered Serial Port (McBSP), McBSP Programming, a CODEC Interface Circuit, CODEC Programming, A CODEC-DSP Interface Example.

TEXT BOOKS

1. Avtar Singh and S. Srinivasan, *Digital Signal Processing*, Thomson Publications,2004.
2. B.Venkata Ramani and M. Bhaskar, *Digital Signal Processors, Architecture, Programming and Applications*, TMH, 2004.

REFERENCES

1. Lapsley, *DSP Processor Fundamentals, Architectures & Features*, S.Chand & Co,2000.
2. Jonatham Stein, *Digital Signal Processing*, John Wiley,2005.
3. K Padmanabhan, R. Vijayarajeswaran, Ananthi. S A Practical Approach To Digital Signal Processing , New Age International, 2006/2009.
4. John Wiley ,Digital Signal Processing – Jonatham Stein, 2005.

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(19EC4006) HIGH SPEED NETWORKS
(Programme Elective –II)

COURSE OBJECTIVES
The objectives of this course:

1. *To learn High speed networks, Traffic and congestion management.*
2. *To understand resource allocation and service management approaches.*
3. *To study wireless network operations and functions.*
4. *To learn network management and its protocols.*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *Gets an in-depth knowledge of High-Speed Networks and TCP/IP protocols.*
2. *Knows about the security and network management.*
3. *Analyze the cause of congestion, traffic slow down and related factors for Quality of Service.*
4. *Understand about ATM and Frame relay.*
5. *Explain the major techniques involved, and networks & systems issues for the design and implementation of High-Speed networks.*

UNIT – I

Network Services & Layered Architecture: Traffic Characterization &Quality of Service – Network Services – High Performance Networks – Network Elements – Basic Network Mechanisms – Layered Architecture.

UNIT – II

ISDN & B-ISDN: Overview of ISDN – ISDN Channels & User Access – ISDN Protocols – Brief History of B-ISDN& ATM – ATM Based Services and Applications – Principles and Building Block of B-ISDN – General Architecture of B-ISDN – Frame Relay.

UNIT – III

ATM Networks: Network Layering – Switching of Virtual Channels and Virtual Paths – Applications of Virtual Channels and Connections – QOS Parameters – Traffic Descriptors – ATM Service Categories – ATM Cell Header – ATM Layer – ATM Adaptation Layer.

UNIT – IV

Interconnection Networks: Introduction – Banyan Networks – Routing Algorithm & Blocking Phenomenon – Batcher-Banyan Networks – Crossbar Switch – Three Stage Class Networks.
Rearrangeable Networks: Re-Arrangeable Class Networks – Folding Algorithm – Bens Network – Looping Algorithm.

UNIT – V

ATM Signalling, Routing and Traffic Control: ATM Addressing – UNI Signalling – PNNI Signalling – PNNI Routing – ABR Traffic Management.

TCP/IP Networks: History of TCP/IP – TCP Application and Services – Motivation – TCP – UDP – IP Services and Header Formats – Internetworking – TCP Congestion Control.

Queue Management: Passive & Active – QOS in IP Networks – Differentiated and Integrated Services.

TEXT BOOKS

1. William Stallings, *ISDN and Broadband ISDN with Frame Relay and ATM*, Pearson Education, 4th Edition, 1998.
2. Alberto Leon-Garcia, Indra Widjaja, *Communication Networks*, Mc Graw Hill Education, 2ndEdition, 2017.

REFERENCES

1. N. N. Biswas, *ATM Fundamentals*, Adventure Books, 1st Edition, 1998.
2. Mahbub Hassan, Raj Jain, *High Performance TCP/IP Networking*, Pearson Education India, 1st Edition, 2015.
3. Rainer Handel, Manfred N.Hubber, Stefan Schroder, *ATM Networks-Concepts, Protocols, Applications*, Pearson Education, 3rd Edition, 2002.
4. William Stallings, *High Speed Networks and Internets*, Pearson Education, 2nd Edition, 2002.

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(19EC4007) VOICE and DATA NETWORKS
(Programme Elective – II)

COURSE OBJECTIVES
The objectives of this course:

1. *To understand the basics of wireless voice and data communication technologies.*
2. *To study the working principles of wireless LAN and its standards.*
3. *To build working knowledge on various Data and voice networks.*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *Design a voice and data network.*
2. *Understand network terminology and network switching.*
3. *Understand about multiple access protocols.*
4. *Design a network with ip addresses and make subnets of the networks.*
5. *Understand quality of service in packet networks.*

UNIT – I
Network Design Issues–Network Performance Issues,– Network Terminology, –Centralized and Distributed Approaches for Networks Design, –Issues In Design of Voice and Data Networks. – Layered And Layer Less Communication, Cross Layer Design Of Networks, –Voice Networks (Wired And Wireless) And Switching, Circuit Switching And Packet Switching, – Statistical Multiplexing.

UNIT – II
Data Networks and Their Design–Link Layer Design– Link Adaptation–Link Layer Protocols – Retransmission Mechanisms: (ARQ), Hybrid ARQ (HARQ), Go Back N, –Selective Repeat Protocols and Their Analysis.

UNIT – III
Queuing Models Of Networks–Traffic Models–Little's Theorem–Markov Chains, M/M/1 and Other Markov Systems–Multiple Access Protocols, Aloha System, Carrier Sensing–Examples of Local AreaNetworks.

UNIT – IV
Inter-Networking: Bridging–Global Internet–IP Protocol And Addressing, Sub Netting, Classless Inter Domain Routing (CIDR)–IP Address Lookup–Routing In Internet–End To End Protocols, TCP And UDP–Congestion Control, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit/ Fast Recovery.

UNIT – V
Congestion Avoidance–RED TCP Throughput Analysis–Quality Of Service In Packet Networks– Network Calculus,–Packet Scheduling Algorithms.

TEXT BOOKS

1. D. Bertsekas and R. Gallager, *Data Networks*, Prentice Hall, 2nd Edition,1992.
2. L. Peterson and B. S. Davie, *Computer Networks: A Systems Approach*, Morgan Kaufman, 5th Edition, 2011.

REFERENCES

1. Kumar, D. Manjunath And J. Kuri, *Communication Networking: An Analytical Approach*, Morgan Kaufman, 1stEdition, 2004.
2. Walrand, *Communications Network: A First Course*, Mc graw Hill, 2ndEdition, 2002.
3. Leonard Kleinrock, *Queuing Systems, Volume I: Theory*, John Wiley and Sons,1st Edition, 1975.
4. Aaron Kershenbaum, *Telecommunication Network Design Algorithms*, Mc graw Hill, 1993.
5. Vijay Ahuja, *Design And Analysis Of Computer Communication Networks*, Mc graw Hill, 1987.

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(19EC4008) WIRELESS SENSOR NETWORKS
(Programme Elective –II)

COURSE OBJECTIVES
The objectives of this course:

1. *To understand the basic WSN technology with basic sensor systems and provide a survey of sensor technology.*
2. *To understand the medium access control protocols, routing and transport layer protocols for sensor networks and address physical layer issues.*
3. *To understand the Sensor management, sensor network hardware, operating systems.*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *Able to understand the basic WSN technology and supporting protocols, with emphasis.*
2. *Able to understand the sensor network hardware and operating systems.*
3. *Able to understand the sensor network protocols and addresses physical layer issues.*
4. *Able to understand and differentiate database management systems, data storage and Query processing.*
5. *Able to design and deploy the sensor networks.*

UNIT –I
Introduction and Overview of Sensor Network, Architecture and its Applications–Sensor Network Comparison with Adhoc Networks–Sensor Node Architecture with Hardware and Software Details.

UNIT–II
Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT
Software (Operating Systems): tiny OS, MANTIS, Contiki, and RetOS – ProgrammingTools, C, nesC–Performance Comparison of Wireless Sensor Networks–Simulation and Experimental Platforms like Open source (ns-2) and Commercial (QualNet, Opnet)

UNIT–III
Overview of Sensor Network Protocols: Physical, MAC and Routing/ Network Layer Protocols, Node Discovery Protocols, Multi-hop and Cluster based Protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy) and UWB.

UNIT–IV
Data Dissemination and Processing, Differences Compared with other Database Management Systems, Data Storage and Query Processing.

UNIT–V
Specialized Features: Energy Preservation and Efficiency–Security Challenges – Fault Tolerance–Issues related to Localization–Connectivity and Topology.

Sensor Deployment Mechanisms: Coverage issues, sensor Web, Sensor Grid - Open Issues for Future Research, and Enabling Technologies in Wireless Sensor Network.

TEXT BOOKS

1. H. Karl and A.Willig, John Wiley & Sons, *Protocols and Architectures for Wireless Sensor Networks*, India,2012.
2. C.S. Raghavendra, K.M. Sivalingam, and T.Znati, *Wireless Sensor Networks,* Editors, Springer Verlag, 1st Indian reprint,2010.

REFERENCES

1. F. Zhao and L. Guibas, Morgan Kaufmann *Wireless Sensor Networks: An Information Processing Approach,*1stIndian reprint, 2013.
2. YingshuLi, MyT. Thai, Weili Wu *Wireless sensor Network and Applications,* Springer series on signals and communication technology, 2008.
3. J. Pan, Y. Hou, L. Cai, Y. Shi and S. Shen, *Topology Control for Wireless Sensor Networks*, in proceedings of 9th International Conference on Mobile Computing and Networking, San Diego, CA, Sept. 2003, pp. 286-299.

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(19EC4009) ADVANCED DIGITAL SIGNAL PROCESSING LAB (Virtual Lab)

COURSE OBJECTIVES
The objectives of this course:

1. *To understand various schemes for digital filter implementations.*
2. *To study different DSP algorithms for computation of DFT.*
3. *To understand various application areas using Signal processing methods.*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *Understand the handling of discrete/digital signals using MATLAB.*
2. *Understand the basic operations of Signal processing.*
3. *Analyze the spectral parameter of window functions.*
4. *Design IIR, and FIR filters for band pass, band stop, low pass and high pass filters.*
5. *Design the signal processing algorithm using MATLAB & VLAB.*

List of Experiments:
1. Study of Sampling theorem, effect of under-sampling.
2. Study of Quantization of continuous-amplitude, discrete-time Analog signals.
3. Study of different types of Companding Techniques.
4. Study of properties of linear time-invariant system.
5. Study of convolution: series and parallel system.
6. Study of Discrete Fourier Transform (DFT) and its inverse.
7. Study of Transform domain properties and its use..
8. Study of FIR filter design using window method: Low pass and high passf ilter.
9. Study of FIR filter design using window method: Band pass and Band stop filter.
10. Study of Infinite Impulse Response (IIR) filter.

Tools Required: MATLAB

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(19EC4010) ADVANCED DIGITAL SYSTEM DESIGN LAB

COURSE OBJECTIVES
The objectives of this course:

1. *To understand concept of various components.*
2. *To understand concepts that underpins the disciplines of Analog and digital electronic logic circuits.*
3. *To describe Various Number system and Boolean algebra.*
4. *To design and implementation of combinational circuits.*
5. *To design and implementation of sequential circuits.*
6. *To describe Hardware description language.*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *Achieve Knowledge and Awareness of various components to design stable analog circuits.*
2. *Represent numbers and perform arithmetic operations.*
3. *Minimize the Boolean expression using Boolean algebra and design it using logic gates*
4. *Analyze and design combinational circuit.*
5. *Design and develop sequential circuits.*
6. *Translate real world problems into digital logic formulations using VHDL.*

List of Experiments:
CYCLE–I:
1. Simulation and Verification of Logic Gates.
2. Design and Simulation of Half adder, Serial Binary Adder, Multi Precession Adder, Carry Look Ahead Adder and Full Adder.
3. Simulation and Verification of Decoder, MUXs, Encoder using all Modeling Styles.
4. Modeling of Flip-Flops with Synchronous and Asynchronous reset.
5. Design and Simulation of Counters-Ring Counter, Johnson Counter, and Up-Down Counter, Ripple Counter.
6. Design of N-bit Register of Serial-in Serial-out, Serial in Parallel out, Parallel in Serial out and Parallel in Parallel Out.
7. Design of Sequence Detector (Finite State Machine-Mealy and Moore Machines).
8. 4-Bit Multiplier, Divider. (for 4-BitOperand)
9. Design ALU to Perform –ADD, SUB, AND-OR, 1's and 2's COMPLIMENT, Multiplication , Division.

CYCLE–II:

Digital Circuit Description Using Verilog / VHDL.

1. Verification of the Functionality of the circuit using function Simulators.
2. Timing Simulator for Critical Path time Calculation.
3. Synthesis of Digital Circuit.
4. Place and Router Techniques for FPGA‟s like Xilinx, Altera , Cypress ,etc.
5. Implementation of Design using FPGA and CPLD Devices.

Tools Required: VHDL or VERILOG

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(19HS0818) ENGLISH FOR RESEARCH PAPER WRITING

COURSE OBJECTIVES
The objectives of this course:

1. *To understand that how to improve writing skills and level of readability.*
2. *To learn about what to write in each section.*
3. *To understand the skills needed when writing a Title.*
4. *To ensure the good quality of paper at very first-time submission.*
5. *To know the strategies and techniques for preparing academic projects.*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *To recognize and demonstrate the style and conventions of research writing.*
2. *To improve the clarity and coherence of their written proposal.*
3. *Able to use a variety of sentence patterns.*
4. *To enhance their revision and proofreading skills.*
5. *To use effective strategies and techniques to construct their academic projects.*

UNIT-I
Planning and Preparation- Word Order- Breaking up long sentences- Structuring Paragraphs and Sentences- Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT-II
Clarifying Who Did What- Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism- Sections of a Paper, Abstracts and Introduction.

UNIT-III
Review of the Literature,-Methods, Results, Discussion, Conclusions and The Final Check.

UNIT-IV
Key skills needed when writing Title- Key skills needed when writing abstract- Key skills needed when writing an Introduction- Skills when writing a Review of the Literature.

UNIT-V
Skills needed when writing the Methods- Skills needed when writing the Results- Skills needed when writing the Discussion- Skills needed when writing the Conclusions.

TEXT BOOKS

1. Adrian Wall work *English for Writing Research Papers*, Springer New York Dordrecht. Heidelberg London, 2011.
2. Adrian Wallwork**,** *English for Academic Correspondence and Socializing*, Kindle Edition, 2011.

REFERENCES

1. Day R *How to Write and Publish a Scientific Paper*, Cambridge University Press, 2006.
2. Highman N *Handbook of Writing for the Mathematical Sciences*, SIAM, Highman's Books, 1998.
3. Goldbort R *Writing for Science*, Yale University Press, 2006.

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(19EC4011) WIRELESS COMMUNICATIONS

COURSE OBJECTIVES
The objectives of this course:

1. *To provide an overview of Wireless Communication and its applications in communication engineering.*
2. *To appreciate the contribution of Wireless Communication networks to overall technological growth.*
3. *To understand the various terminology, principles, devices, schemes, concepts, algorithms and different methodologies used in Wireless Communication.*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *To understand the basics of Wireless Communication.*
2. *To motivate the students to pursue research in the area of wireless communication.*
3. *Analyze and design receiver and transmitter diversity techniques.*
4. *Analyze Multiuser Systems, SSMA, CDMA network planning.*
5. *Summarize the principles of MIMO and specifications of communication standards.*

Unit–I
Introduction to Wireless Communications Systems: Evolution, Examples of Wireless Communication Systems, Comparison–Second Generation Cellular Networks, WLL, Bluetooth and Personal Area Networks.

Unit–II
Mobile Radio Propagation: Large-Scale Path Loss, Introduction to Radio Wave Propagation, Free Space Propagation Model, Propagation Mechanisms, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering. Small-Scale Fading and Multipath, Impulse Response Model of a Multipath Channel, Small- Scale Multipath Measurements, Parameters of Mobile Multipath Channels, Types of Small-Scale Fading, Rayleigh and Ricean Distributions, Statistical Models for Multipath Fading Channels, Theory of Multipath Shape Factors for Small-Scale Fading Wireless Channels.

Unit–III
Diversity Techniques: Repetition Coding and Time Diversity–Frequency and Space Diversity, Receive Diversity–Concept of Diversity Branches and Signal Paths– Combining Methods–Selective Diversity Combining –Switched Combining– Maximal Ratio Combining– Equal Gain Combining–Performance Analysis for Rayleigh Fading Channels.
Cellular Communication: Cellular Networks, Multiple Access: FDM/TDM/FDMA/TDMA,

Spatial Reuse, Co-Channel Interference Analysis, Hand Over Analysis, Erlang Capacity Analysis, Spectral Efficiency and Grade of Service- Improving Capacity – Cell Splitting and Sectorization.

Unit–IV

Spread Spectrum and CDMA: Motivation–Direct Sequence Spread Spectrum– Frequency Hopping Systems, Time Hopping., Anti-Jamming–Pseudo Random (PN) Sequence, Maximal Length Sequences, Gold Sequences, and Generation of PN Sequences.

Diversity in DS-SS Systems: Rake Receiver- Performance Analysis. Spread Spectrum Multiple Access, CDMA Systems–Interference Analysis for Broadcast and Multiple Access Channels, Capacity of Cellular CDMA Networks–Reverse Link Power Control, Hard and Soft Hand Off Strategies.

Unit–V

Fading Channel Capacity: Capacity of Wireless Channels–Capacity of Flat and Frequency Selective Fading Channels–Multiple Input Multiple Output (MIMO) Systems, Narrow Band Multiple Antenna System Model, Parallel Decomposition of MIMO Channels–Capacity of MIMO Channels.

Cellular Wireless Communication Standards: GSM Specifications and Air Interface, Specifications, IS 95 CDMA- 3G Systems: UMTS & CDMA 2000 Standards and Specifications.

TEXT BOOKS

1. Andrea Goldsmith, *Wireless Communications*, Cambridge University press.
2. T.S. Rappaport, *Wireless Communications*, Principles & Practice, PHI,2001.

REFERENCES

1. G.L Stuber, *Principles of Mobile Communications,* 2nd Edition, Kluwer Academic Publishers.
2. Kamilo Feher, *Wireless Digital Communication,* PHI,1995.
3. R.L Peterson, R.E. Ziemer and David E. Borth, *Introduction to Spread Spectrum Communication,* Pearson Education.
4. A.J.Viterbi, *CDMA- Principles of Spread Spectrum,* Addison Wesley,1995.
5. Simon Haykin and Michael Moher, *Modern Wireless Communications,* Person Education.

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(19EC4012) CODING THEORY & TECHNIQUES

COURSE OBJECTIVES
The objectives of this course:

1. *Introduce the principles and applications of information theory.*
2. *To teach coding schemes, including error correcting codes.*
3. *Explain how this quantitative measure of information may be used in order to build efficient solutions to multitudinous engineering problems.*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *Knowledge of properties and algorithms of linear block codes.*
2. *Apply coding theory and linear algebra in source coding and channel coding.*
3. *Understand various error control encoding and decoding techniques.*
4. *Knowledge of properties and algorithms of cyclic codes and convolution codes.*
5. *Analyze the performance of error control codes.*

UNIT – I
Source Coding: Mathematical model of Information, A Logarithmic Measure of Information, Average and Mutual Information and Entropy – Coding for Discrete less sources, Source coding theorem, fixed length and variable length coding, properties of prefix codes.

UNIT – II
Coding Techniques: Shannon-Fano coding – Huffman code, Huffman code applied for pair of symbols, efficiency calculations - Lempel-Ziv codes.
Linear Block Codes: Introduction to Linear block codes, Generator Matrix, Systematic Linear Block codes, Encoder Implementation of Linear Block Codes – Parity Check Matrix, Syndrome testing, Error Detecting and correcting capability of Linear Block codes.

UNIT – III
Hamming Codes: Probability of an undetected error for linear codes over a Binary Symmetric Channel, Weight Enumerators and Mac-Williams identities, Perfect codes, Application of Block codes for error control in data storage Systems.

UNIT – IV
Cyclic Codes: Algebraic structure of cyclic codes, Binary Cyclic code properties, Encoding in systematic and non-systematic form – Encoder using (n-k) bit shift register, Syndrome Computation and Error detection, Decoding of Cyclic Codes.

Convolutional Codes: Encoding of Convolutional codes, Structural properties of Convolutional codes, state diagram, Tree diagram, Trellis Diagram, Maximum Likelihood decoding of Convolutional codes.

UNIT – V

Viterbi Algorithm, Fano and Stack Sequential decoding algorithms, Application of Viterbi and sequential decoding.

BCH Codes: Groups – fields, binary Fields arithmetic, construction of galois fields GF (2m), Basic properties of galois Fields, Computation using galois Field GF (2m) arithmetic - Description of BCH codes, Decoding procedure for BCH codes.

TEXTBOOKS

1. John G. Proakis, *Digital Communications,* Mc Graw Hill Publication, 2004.
2. K. Sam Shanmugam, *Digital and Analog Communication Systems,* Wisley Publications, 2006.

REFERENCES

1. SHU LIN and Daniel J. Costello, *Error Control Coding-Fundamentals and Applications,* Jr. Prentice Hall Inc, 2005.
2. Bernard sklar, *Digital Communications-Fundamental and Application,* Pearson Education, Asia, 2004.
3. Man Young Rhee, *Error Control Coding Theory,* McGraw Hill Publications, 2005.

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(19EC4109) INTRODUCTION TO IoT
(Programme Elective –III)

COURSE OBJECTIVES
The objectives of this course:

1. *To explore the world of current technologies.*
2. *To understand with the concepts of internet of things.*
3. *To get a knowledge basics in the history and developments of internet.*
4. *To be familiar with the big data and cloud in the IoT basis.*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *Discuss the world of current technologies.*
2. *Describe the major application areas of IoT.*
3. *Describe about the networking in IoT.*
4. *Apply the concepts of python programming in IoT.*
5. *Design & develop IoT applications using python.*

UNIT – I
Introduction & Concepts: Introduction to Internet of Things – Physical Design of IOT – Logical Design of IoT – IoT Enabling Technologies – IoT Levels.

UNIT – II
Domain Specific IoTs: Home Automation – Cities – Environment – Energy – Retail - Logistics – Agriculture – Industry - Health & Life Style.

UNIT – III
M2M & System Management with NETCONF-YANG: M2M – Difference between IoT and M2M – SDN and NFV for IoT – Software defined Networking – Network Function Virtualization – Need for IOT Systems Management – Simple Network Management Protocol – Limitations of SNMP – Network Operator Requirements – NETCONF – YANG – IOT Systems management with NETCONF-YANG.

UNIT – IV
Developing Internet of Things & Logical Design using Python: Introduction, IoT Design Methodology – Installing Python – Python Data Types & Data Structures – Control Flow – Functions – Modules – Packages – File Handling – Date/ Time Operations – Classes – Python Packages.

UNIT – V

IoT Physical Devices & Endpoints: What is an IoT Device – Exemplary Device – Board, Linux on Raspberry Pi – Interfaces and Programming IoT Devices.

TEXT BOOKS

1. Vijay Madisetti, Arshdeep Bahga, *Internet of Things a Hands-on Approach,* University press,,1st Edition, 2014.
2. Adrian McEwen,*Designing the Internet of Things,*Wiley Publishers, 1st Edition, 2013.

REFERENCES

1. Daniel Kellmereit, Daniel Obodovski , *The Silent Intelligence: The Internet of Things,* DND Ventures LLC ,1st Edition, 2013.
2. Samuel Greenland, *The Internet of Things,* MIT Press, 1st Edition, 2015.
3. Patrick Grossetete, Gonzalo Salgueiro, David Hanes, *IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things,* Pearson, 1st Edition, 2015.

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(19EC4013) ADAPTIVE SIGNAL PROCESSING
(Programme Elective –III)

COURSE OBJECTIVES
The objectives of this course:

1. *To understand the basics of adaptive system.*
2. *To make familiar with gradient search algorithms and functions.*
3. *To introduce LMS & RLS algorithms.*
4. *To be acquainted with random variables and Kalman filters*.

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *Comprehend adaptive system and functions.*
2. *Understand the design criteria for a linear adaptive processor.*
3. *Develop different adaptive modelling systems.*
4. *Understand the properties of Kalman filtering.*
5. *Understand the properties of Non-Linear Adaptive Filtering.*

UNIT – I
Eigen Analysis: Eigen Value Problem, Properties of Eigen values and Eigen vectors, Eigen Filters, Eigen Value computations.
Introduction to Adaptive Systems: Definitions, Characteristics, Applications, Example of an Adaptive System– The Adaptive Linear Combiner, Description, Weight Vectors, Desired Response Performance function, Gradient & Mean Square Error.

UNIT – II
Development of Adaptive Filter Theory & Searching the Performance Surface: Introduction to Filtering, Smoothing and Prediction, Linear Optimum Filtering, Problem Statement, Principle of Orthogonality, Minimum Mean Square Error, Wiener- Hopf Equations, Error Performance , Minimum Mean Square Error.
Searching the Performance Surface: Methods & Ideas of Gradient Search Methods, Gradient Searching Algorithm & its Solution, Stability & Rate of Convergence -Learning Curves.

UNIT – III
Steepest Descent Algorithms: Gradient Search by Newton's Method, Method of Steepest Descent, Comparison of Learning Curves.
LMS Algorithm & Applications: Overview , LMS Adaptation algorithms, Stability &Performance Analysis of LMS Algorithms, LMS Gradient & Stochastic Algorithms, Convergence of LMS Algorithm.

Applications: Noise Cancellation, Cancellation of Echoes in Long Distance Telephone Circuits, Adaptive Beam forming.

UNIT – IV

RLS Algorithm: Matrix Inversion lemma, Exponentially Weighted Recursive Least Square Algorithm, Update Recursion for The Sum of Weighted Error Squares, Convergence Analysis of RLS Algorithm, Application of RLS algorithm on Adaptive Equalization.

UNIT – V

Kalman Filtering: Introduction, Recursive Mean Square Estimation Random Variables, Statement of Kalman Filtering problem, Filtering, Initial Conditions, Variants of Kalman filtering, Extend Kalman Filtering.

Non-Linear Adaptive Filtering: Theoretical and Practical Considerations of Blind Deconvolution, Buss Gang Algorithm for Blind Equalization of Real Baseband Channels.

TEXTBOOKS

1. Bernard Widrow, Samuel D.Strearns, *Adaptive Signal Processing*,PE,2005.
2. Simon Haykin, *Adaptive Filter Theory*, PEAsia,4th Edition, 2002.

REFERENCES

1. Sophocles.J.Orfamadis, *Optimum signal processing: An introduction*, 2nd Edition, Mc Graw Hill, 1998.
2. St.Thomas, Alexander, *Adaptive signal processing-Theory and Applications*, Springer, 1986.
3. A.V.Oppenhiem, R W Schafer, *Discrete-Time Signal Processing*, Pearson Education.

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(19EC4014) COGNITIVE RADIO
(Programme Elective –III)

COURSE OBJECTIVES
The objectives of this course:

1. *An understanding on software defined radio architecture and design principles.*
2. *An understanding on cognitive radio components, functions and capabilities.*
3. *An ability to evaluate different spectrum sensing mechanisms in cognitive radio.*
4. *An ability to analyse the spectrum management functions using cognitive radio systems and cognitive radio networks.*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *Demonstrate an understanding on software defined radio architecture and design principles.*
2. *Demonstrate an understanding on cognitive radio components, functions and capabilities.*
3. *Evaluate different spectrum sensing mechanisms in cognitive radio.*
4. *Analyse the spectrum management functions using cognitive radio systems and cognitive radio networks.*
5. *Demonstrate an understanding on cooperative communications.*

UNIT – I
Introduction To Cognitive Radio: Digital Dividend – Cognitive Radio (CR) Architecture – Functionsof Cognitive Radio – Dynamic Spectrum Access (DSA) – Components of Cognitive Radio – Spectrum Sensing, Spectrum Analysis and Decision – Potential Applications of Cognitive Radio.

UNIT – II
Spectrum Sensing: Spectrum Sensing – Detection of Spectrum Holes (TVWS) – Collaborative Sensing – Geo-Location Database and Spectrum Sharing Business Models (Spectrum of Commons, Real Time Secondary SpectrumMarket).

UNIT – III
Optimization Techniques of Dynamic Spectrum Allocation: Linear Programming – Convex Programming – Non-Linear Programming – Integer Programming – Dynamic Programming – Stochastic Programming.

UNIT – IV
Dynamic Spectrum Access and Management: Spectrum Broker – Cognitive Radio Architectures – Centralized Dynamic Spectrum Access – Distributed Dynamic Spectrum Access – Learning Algorithms and Protocols.

UNIT – V

Spectrum Trading: Introduction to Spectrum Trading – Classification to Spectrum Trading – Radio Resource Pricing – Brief Discussion on Economics Theories in DSA (Utility, Auction Theory) – Classification of Auctions (Single Auctions, Double Auctions, Concurrent, Sequential).
Research Challenges in Cognitive Radio: Network Layer and Transport Layer Issues – Cross Layer Design for Cognitive Radio Networks.

TEXT BOOKS

1. Ekram Hossain, Dusit Niyato, Zhu Han, *Dynamic Spectrum Access and Management in Cognitive Radio Networks,* Cambridge University Press, 2009.
2. Kwang-Cheng Chen, Ramjee Prasad, *Cognitive radio networks,* John Wiley & Sons Ltd.,2009.

REFERENCES

1. Bruce Fette, *Cognitive radio technology*, Elsevier, 2nd Edition,2009.
2. HuseyinArslan,*Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems,* Springer,2007.
3. Francisco Rodrigo Porto Cavalcanti, SorenAndersson,*Optimizing Wireless Communication Systems,* Springer,2009.
4. Linda Doyle,*Essentials of Cognitive Radio,* Cambridge University Press,2009.

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(19EC4015) IMAGE & VIDEO PROCESSING
(Programme Elective –IV)

COURSE OBJECTIVES
The objectives of this course:

1. *Develop an overview of the field of image processing.*
2. *Understand the fundamental algorithms and how to implement them.*
3. *Prepare to read the current image processing research literature.*
4. *Gain experience in applying image processing algorithms to real problems.*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *Describe and use the principles of digital image and video processing to develop image processing algorithms.*
2. *Implement (for example with MATLAB) and assess the developed image processing algorithms.*
3. *Explain algorithm design choices using the principles of digital image/video processing.*
4. *Develop image processing algorithms for a given practical image/video processing problem.*
5. *Solve more advanced problems in all areas mentioned above*
6. *Identify and explain the challenges, propose possible solutions, and explain the chosen algorithm design.*

UNIT – I
Image Representation: Gray Scale And Color Images– Image Sampling And Quantization– Two Dimensional Orthogonal Transforms: DFT, WT, HAAR Transform, KLT, And DCT.

UNIT – II
Image Enhancement: Filters In Spatial And Frequency Domains– HistogramBased Processing, And Homomorphic Filtering– Edge Detection, Non-Parametric And Model Based Approaches– LOG Filters– Localization Problem.

UNIT – III
Image Restoration: Degradation Models, PSF, Circulant And Block Circulant Matrices – De-Convolution – Restoration Using Inverse Filtering: Wiener Filtering And Maximum Entropy Based Methods – Morphological Operations.
Image Segmentation: Pixel Classification – Bi-Level Thresholding – Multi-Level Thresholding: P-Tile Method, Adaptive Thresholding – Spectral & Spatial Classification – Hough Transform – Region Growing.

UNIT – IV
Image Compression: Compression Models – Information Theoretic Perspective – Fundamental Coding Theorem.

Lossless Compression: Huffman Coding – Arithmetic Coding – Bit Plane Coding – Run Length Coding – Lossy Compression: Transform Coding, Image Compression Standards.

UNIT – V

Video Processing: Representation Of Digital Video – SpatioTemporal Sampling – Motion Estimation – Motion Compensation – Video Filtering, Video Compression – Video Coding Standards.

TEXT BOOKS

1. R. C. Gonzalez, R. E. Woods, *Digital Image Processing*, Pearson Education. 2nd Edition, 2002.
2. W. K. Pratt, *Digital Image Processing*, Prentice Hall, 1989.

REFERENCES

1. A. Rosenfold and A. C. Kak, *Digital Image Processing*, Vols. 1 And 2, PHI, 1986.
2. H. C. Andrew and B. R. Hunt,*Digital Image Restoration*, PrenticeHall,1977.
3. R. Jain, R.Kasturi and B.G.Schunck, *Machine Vision*,Mgh International Edition,1995.

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(19EC4016) PATTERN RECOGNITION AND MACHINE LEARNING
(Programme Elective –IV)

COURSE OBJECTIVES
The objectives of this course:

1. *To equip students with basic mathematical and statistical techniques commonly used in pattern recognition.*
2. *To introduce students to a variety of pattern recognition algorithms.*
3. *Enable students to apply machine learning concepts in real life problems.*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *Able to understand the Bayesian approach to pattern recognition.*
2. *Able to Understand Linear Models for Regression and Classification.*
3. *Analyze the performance of neural networks.*
4. *Able to Understand Linear Discriminant Functions for Machine Learning.*
5. *Able to Understand Algorithm Independent MachineLearning.*

UNIT – I

Introduction to Pattern Recognition: Problems, Applications, Design Cycle, Learning and Adaptation, Examples, Probability Distributions, Parametric Learning – Maximum Likelihood and Bayesian Decision Theory – Bayes Rule, Discriminant Functions, Loss Functions and Bayesian Error Analysis.

UNIT – II

Linear Models: Linear Models for Regression, Linear Regression,Logistic Regression, Linear Models for Classification.

UNIT – III

Neural Network: Perceptron, Multi-Layer Perceptron, Back propagation Algorithm, Error Surfaces, Practical Techniques for Improving Back propagation, Additional Networks and Training Methods, Adaboost, Deep Learning.

UNIT – IV

Linear Discriminant Functions: Decision Surfaces, Two-Category, Multi-Category, Minimum Squared Error Procedures, Ho-Kashyap Procedures, Linear Programming Algorithms, Support Vector Machine.

UNIT – V

Algorithm Independent Machine Learning: Lack of Inherent Superiority of any Classifier, Bias and Variance, Re-Sampling for Classifier Design, Combining Classifiers.

Unsupervised Learning and Clustering: K-Means Clustering, Fuzzy K-Means Clustering, Hierarchical Clustering.

TEXT BOOKS

1. Richard O. Duda, Peter E. Hart, David G. Stork, *Pattern Classification,* John Wiley & Sons,2nd Edition,2001.
2. Trevor Hastie, Robert Tibshirani, Jerome H. Friedman,*The Elements of Statistical Learning,*Springer,2nd Edition, 2009.

REFERENCES

1. C. Bishop, *Pattern Recognition and Machine Learning,* Springer,2006.
2. Tom M Mitchell, *Machine Learning,* Mc Graw Hill,Indian Edition.
3. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, *Introduction to Statistical Learning,* Springer, 2013.

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(19EC4017) DETECTION & ESTIMATION OF SIGNALS
(Programme Elective –IV)

COURSE OBJECTIVES
The objectives of this course:

1. *The subject of signal detection and estimation is concerned with the processing of information-bearing signals for the purpose of making inferences about the information that they contain.*
2. *To introduce the fundamental theoretical principles are underlying the development and analysis of techniques for such processing.*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *To enable the students to acquire the fundamental concepts of Signal Detection and Estimation.*
2. *To get familiarize with different Hypotheses in detection and estimation problems*
3. *Use classical and Bayesian approaches to formulate and solve problems for parameter estimation from noisy signals.*
4. *To introduce the methods of Detection and estimation of signals in white and non-white Gaussian noise.*
5. *To enable the students to understand the time varying waveform detection and its estimation.*

UNIT – I
Detection Theory: Binary Decisions – Single Observation – Maximum Likelihood Decision Criterion –Neyman-Pearson Criterion – Probability of Error Criterion – Bayes Risk Criterion – Min-Max Criterion – Robust Detection – Receiver Operating Characteristics.

UNIT – II
Binary Decisions – Multiple Observations: Vector Observations – The General Gaussian Problem – Waveform Observation in Additive Gaussian Noise, The Integrating Optimum Receiver – Matched Filter Receiver.

UNIT – III
Estimation Theory: Methods – Maximum Likelihood Estimation – Bayes Cost Method – Bayes Estimation Criterion – Mean Square Error Criterion – Uniform Cost Function – Absolute Value Cost Function – Linear Minimum Variance – Least Squares Method – Estimation in the Presence of Gaussian Noise – Linear Observation – Non-Linear Estimation.

UNIT – IV
Properties of Estimators: Bias – Efficiency – Cramer-Rao Bound Asymptotic Properties – Sensitivity and Error Analysis.
State Estimation: Prediction –Kalman Filter.

UNIT – V

Sufficient Statistics and Statistical Estimation of Parameters: Concept of Sufficient Statistics – Exponential Families of Distributions – Exponential Families and Maximum Likelihood Estimation – Uniformly Minimum Variance Unbiased Estimation.

TEXT BOOKS

1. James L. Melsa and David L. Cohn, *Decision and Estimation Theory*, McGraw-Hill Inc., 1st Edition, 1978.
2. Dimitri Kazakos, P. Papantoni Kazakos, *Detection and Estimation*, Computer Science Press, 2nd Edition, 1990.

REFERENCES

1. Steven M. Kay,*Statistical Signal Processing and Detection Theory*, Prentice Hall Inc., 2nd Edition, 1998.
2. Harry L. Van Trees, *Detection, Estimation and Modulation Theory, Part 1*, John Wiley & Sons Inc., 1st Edition, 1968.
3. Jerry M. Mendel, *Lessons in Estimation Theory for Signal Processing, Communication and Control*, Prentice Hall Inc., 2nd Edition, 1995.

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(19EC4018) ADVANCED COMMUNICATIONS LAB (Virtual Lab)

COURSE OBJECTIVES
The objectives of this course:

1. *To get better understanding the concept of Frequency Reuse.*
2. *To understand the different advanced communication techniques and their importance in Real time applications.*
3. *Understanding and obtaining the Beam pattern of microwave antennas.*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *Understand the concepts behind various digital signaling schemes for fading channels.*
2. *Understand the concept of co-channel interference & Signal to Interference and Noise Ratio.*
3. *Understand the importance of Sectoring & Handoff.*
4. *Understand the impact of shadowing and path loss exponent on boundary coverage probability.*
5. *Understand the various Path losses that occur in real time.*

List of Experiments:
1. Understanding of Path loss.
2. Path loss with Shadowing.
3. Horizontal and Vertical Beam Pattern.
4. Calculation of Boundary Coverage Probability.
5. Calculation of SINR including Beam Tilt.
   A: Downlink
   B: Uplink
6. Frequency Reuse
   A: Co-Channel Cells.
   B: Cell Cluster.
7. Sectoring.
8. Handoff.
9. Flat Fading.
10. Frequency Selective Fading.

Tools Required: MATLAB

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(19EC4019) IMAGE & VIDEO PROCESSING LAB

COURSE OBJECTIVES
The objectives of this course:

1. *To expose students to basic principles and advanced concepts of digital image processing.*
2. *To design and implement algorithms that perform basic image processing operations like filtering of noise and image enhancement.*
3. *To design, analyze and implement algorithms for advanced image analysis like image compression, image reconstruction, image segmentation.*
4. *To enable students to implements solutions for complex image processing problems.*
5. *To learn different types of image enhancement and restoration techniques.*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *Examine various types of images, intensity transformations and applying various filtering techniques.*
2. *Identify the suitable image enhancement and restoration techniques based upon the application.*
3. *Show how higher-level image concepts such as edge detection, segmentation, representation can be implemented and used.*
4. *To manipulate both binary and gray scale digital images using morphological filters and operators to achieve a desired result.*
5. *Apply image processing algorithms in practical applications.*

List of Experiments:
1. Perform basic operations on images like addition, subtraction etc.
2. Plot the histogram of an image and perform histogram equalization.
3. Implement segmentation algorithms.
4. Perform video enhancement.
5. Perform video segmentation.
6. Perform image compression using lossy technique.
7. Perform image compression using lossless technique.
8. Perform image restoration.
9. Convert a colour model into another.
10. Calculate boundary features of an image.
11. Calculate regional features of an image.
12. Detect an object in an image/video using template matching/ Bayes classifier.

Tools Required: MATLAB

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(19HS0829) CONSTITUTION OF INDIA

COURSE OBJECTIVES
The objectives of this course:

1. *To know the premises informing the twin themes of liberty and freedom from a civil rights perspective.*
2. *To address the growth of Indian opinion regarding modern Indian intellectuals 'constitutional role*
3. *To address entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.*
4. *To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution*
5. *To acquire knowledge for various competitive examinations*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *Explain the key concepts of political economy*
2. *Analyse the significant developments in the political ideologies*
3. *Describe the salient features of the constitution of India interpret, integrate and critically*
4. *Analyse the political economy of Indian international relations and gain knowledge in Judiciary system*
5. *Apply their knowledge and skills acquired to write various competitive examinations*

UNIT-I
Introduction to the Constitution.

UNIT-II
Historical Perspective of the Constitution of India- Salient features and characteristics of the Constitution of India.

UNIT-III
Scheme of the fundamental rights-The scheme of the Fundamental Duties and its legal status-The Directive Principles of State Policy – Its importance and implementation.

UNIT-IV
Parliamentary Form of Government in India – Powers and Functions-The President of India - Status and Powers -The historical perspectives of the constitutional amendments in India-Judiciary system - Powers and Functions

UNIT-V

Local Self Government – Constitutional Scheme in India - Election Commission: Role and Functions.

TEXT BOOKS

1. Government of India Ministry of Law and Justice (Legislative Department) *The Constitution of India, 1950 (Bare Act)* Government Publication, 2015
2. Dr. S. N. Busi, *Dr. B. R. Ambedkar framing of Indian Constitution*, 1st Edition, Government Publication 2015.

REFERENCES

1. M. P.Jain, *Indian Constitution Law* Lexis Nexis 7th Edn., 2014.
2. D.D. Basu, *Introduction to the Constitution of India* Lexis Nexis, 2015
3. P.M.Bakshi, *Constitution of India* Universal Law Publishing,15th Edition, 2018

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(19EC4021) OPTICAL NETWORKS
(Programme Elective - V)

COURSE OBJECTIVES
The objectives of this course:

1. *To develop the knowledge on various components of optical networks, optical layers and losses.*
2. *To understand the multiplexing techniques, fiber characteristics, optical amplifiers and cross connectors.*
3. *To understand the network management, access networks, internetworking and its layers.*

COURSE OUTCOMES (COs)
On successful completion of this course, the student will be able to

1. *Describe the various layers involved in network & Recall basic laws of optical physics.*
2. *Identify the necessity for using couplers and connectors in energy transmission.*
3. *Identify the various multiplexing the techniques.*
4. *Recall basic of multiplexers add/drop.*
5. *Identify different types of protection in SONET/SDH.*
6. *Explain the use of cost tradeoffs & Able to know the overview of access network.*

UNIT – I
Optical Fiber Components: Couplers, Isolators and Circulators, Multiplexers, Bragg grating, Fabry-perot Filters, Mach zender interferometers, Arrayed waveguide grating, Tunable filters, Hi-channel count multiplexer architectures, Optical amplifiers, Direct and External modulation transmitters, Pump sources for amplifiers, Optical switching and Wave length converters.

UNIT – II
Client Layers of Optical Networks: SONET / SDH – Multiplexing, Frame Structure, Physical Layer, Infrastructure, ATM – Functions, Adaptation layers, QoS, Flow Control Signaling and Routing, IP – Routing, QoS, MPLS, Storage Area Networks – ESCON, Fiber Channel, HIPPI.

UNIT – III
WDM Network Elements and Design: Optical Line Terminals and Amplifiers, Add/Drop Multiplexers, Optical Cross Connects, Cost trade-offs in Network Design, LTD and RWA Problems, Dimensioning – Wavelength Routing Networks.

UNIT – IV

Network Control, Management and Survivability: Network Management Functions, Optical Layer Services and Interfacing, Layers within Optical Layer, Multivendor Interoperability, Performance and Fault Management, Basic Concepts of Survivability, Protection in SONET/SDH Links and Rings, Protection in IP Networks, Optical Layer Protection – Service Classes, Protection Schemes, Interworking between Layers.

UNIT – V

Access Networks and Photonic Packet Switching: Network Architecture, Enhanced HFC, FTTC, Photonic Packet Switching – OTDM, Synchronization, Header Processing, Buffering, Burst Switching.

TEXT BOOKS

1. Rajiv Ramaswami and Kumar N. Sivarajan, *Optical Networks: A Practical Perspective,* 2nd edition 2004, Elsevier Morgan Kaufmann Publishers (An Imprint of Elsevier).
2. C. Siva Rama Murthy and Mohan Guruswamy, *WDM Optical Networks: Concepts,Design and Algorithms*, 2nd edition, 2003,PEI.

REFERENCES

1. John.M.Senior, *Optical Fiber Communications: Principles and Practice,* 2nd edition, 2000, PE.
2. Harold Kolimbris, *Fiber Optics Communication*, 2nd Ed., 2004,PEI.
3. Biswanath Mukherjee, *Optical Communication Networks*, New York, McGraw-Hill, 1997.

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(19EC4213) TESTING & TESTABILITY
(Programme Elective - V)

COURSE OBJECTIVES
The objectives of this course:

1. *To know Fundamentals of Testing and Testability, different levels of modeling and simulation, Fault models and Automatic Test Pattern Generation.*
2. *To develop Testability Trade-Offs, Scan Architectures and Compression Techniques.*
3. *To understand BIST Concepts, Test Pattern Generation and Advanced BIST Concepts, Memory Test Architectures, In Circuit Testing (ICT), JTAG Testing Features.*

COURSE OUTCOMES (COs)
On successful completion of this course, the student will be able to

1. *Understand the elementary concepts of Testing and Testability.*
2. *Understand different types of faults associated with logic circuits and types of testing by employing fault models to the logic circuits.*
3. *Get complete knowledge about different methods of simulation and algorithms associated with testing.*
4. *Analyze BIST concepts and design self-test at Board Level.*
5. *Analyze Memory Test Requirements for MBIST and Embedded Core Testing.*
6. *Apply the concepts in testing which can help them design a better yield in IC design.*

UNIT – I
Introduction to Test and Design for Testability (DFT) Fundamentals: Modeling: Modeling Digital Circuits at Logic Level, Register Level and Structural Models, Levels of Modeling, Logic Simulation: Types of Simulation, Delay Models, Element Evaluation, Hazard Detection, Gate Level Event Driven Simulation.

UNIT – II
Fault Modeling: Logic Fault Models, Fault Detection and Redundancy, Fault Equivalence and Fault Location. Single Stuck and Multiple Stuck – Fault Models. Fault Simulation Applications, General Techniques for Combinational Circuits.

Testing for Single Stuck Faults (SSF): Automated Test Pattern Generation (ATPG/ATG) for SSFs in Combinational and Sequential Circuits, Functional Testing with Specific Fault Models.

UNIT – III

Design For Testability: Testability Trade-Offs, Techniques, Scan Architectures and Testing – Controllability and Absorbability, Generic Boundary Scan, Full Integrated Scan, Storage Cells for Scan Design, Board Level and System Level DFT Approaches, Boundary Scans Standards, Compression Techniques – Different Techniques, Syndrome Test and Signature Analysis.

UNIT – IV

Built-In Self-Test (BIST): BIST Concepts and Test Pattern Generation. Specific BIST Architectures: CSBL, BEST, RTS, LOCST, STUMPS, CBIST, CEBS, RTD, SST, CATS, CSTP, BILBO. Brief Ideas on Some Advanced BIST Concepts and Design for Self- Test at Board Level

UNIT – V

Memory BIST (MBIST): Memory Test Architectures and Techniques – Introduction to Memory Test, Types of Memories and Integration, Embedded Memory Testing Model. Memory Test Requirements for MBIST

Brief Ideas on Embedded Core Testing: Introduction to Automatic in Circuit Testing (ICT), JTAG Testing Features.

TEXT BOOKS

1. MironAbramovici, Melvin A. Breur, Arthur D.Friedman,*Digital Systems Testing and Testable Design*,Jaico Publishing House, 2001.
2. Alfred Crouch, *Design for Test for Digital ICs & Embedded Core Systems*, PrenticeHall.

REFERENCES

1. Robert J.Feugate, Jr., Stevenm.Mentyn, *Introduction to VLSI Testing, Prentice Hall*, Englehood Cliffs, 1998.

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(19EC4022) RF AND MICROWAVE CIRCUIT DESIGN
(Programme Elective -V)

COURSE OBJECTIVES
The objectives of this course:

1. *Tounderstand the concepts of microwave network analysis.*
2. *To design various impedance matching devices and knowledge of passive microwave components.*
3. *To understand the analysis of Waveguides and gain complete knowledge about microwave components.*
4. *To Analyze and study about the characteristics of microwave tube generators and amplifiers.*

COURSE OUTCOMES (COs)
On successful completion of this course, the student will be able to

1. *Establish and develop the overall knowledge of RF and microwave circuits and devices and relation between different parameters.*
2. *Design impedance matching network for any transmission line or system and familiarity with passive microwave components.*
3. *Use Smith Chart in RF applications.*
4. *Model and analyze the characteristics of microwave semiconductor diodes and transistors.*
5. *Analyze and find applications and limitations of microwave tube Generators and Amplifiers.*
6. *Evaluate the Performance of RF active circuits through EDA tools*.

UNIT-I
Transmission Line Theory: Lumped Element Circuit Model for Transmission Line,Field Analysis, The Smith Chart, Quarter Wave Transformer, Generator and Load Mismatch – Impedance Matching and Tuning.

UNIT-II
Microwave Network Analysis: Impedance and Equivalent Voltage and Current, Impedance and Admittance Matrix, Scattering Matrix, Transmission Matrix, Signal Flow Graph.

UNIT-III
Microwave Components: Microwave Resonators – Microwave Filters – Power Dividers and Directional Couplers, Ferromagnetic Devices and Components. Nonlinearity and Time Variance – Inter-Symbol Interference –Random Process & Noise, Definition of Sensitivity and Dynamic Range, Conversion Gain and Distortion.

UNIT-IV

Microwave Semiconductor Devices and Modeling:PIN Diode, Tunnel Diode, Varactor Diode, Schottky Diode, IMPATT And TRAPATT Devices, Transferred Electron Devices, Microwave BJTs, GaAs FETs, Low Noise and Power GaAs FETs, MESFET, MOSFET, HEMT.

UNIT-V

Amplifiers Design: Power Gain Equations, Stability, Impedance Matching, Constant Gain and Noise Figure Circles, Small Signal, Low Noise, High Power and Broadband Amplifier, Oscillators, Mixers Design.

TEXT BOOKS

1. Matthew M. Radmanesh, *Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design,* Author House, Updated & Advanced Edition, 2009.
2. D.M.Pozar, *Microwave engineering,* Wiley, 4th Edition,2011.
3. R.Ludwig and P.Bretchk, *RF Circuit Design,* Pearson Education Inc, 2nd Edition, 2009.

REFERENCES

1. G.D.Vendelin, A.M.Pavoi, U. L. Rohde, *Microwave Circuit Design Using Linear and Non-Linear Techniques,* John Wiley, 1990.
2. S.Y. Liao, *Microwave circuit Analysis and Amplifier Design,* Prentice Hall, 1987.
3. *RF and Microwave Electronics Illustrated Radmanesh,* Pearson Education, 2004.

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(19HS0824) BUSINESS ANALYTICS
(Open Elective)

COURSE OBJECTIVES
The objectives of this course:

Course objectives:

1. *Understand the concepts and methods of business analytics.*
2. *To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.*
3. *Identify the management related issues and processes to resolve*
4. *Understand the significance of forecasting models helpful in decision making*
5. *To become familiar with processes needed to develop, report, and analyze business data.*

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
2. Design alternatives to solve business problems utilizing quantitative analysis, critical thinking and sound ethical decision making.
3. Summarize, process and transform data for obtaining meaningful conclusions
4. Interpret data using latest data analytics tools to address organisational problems
5. Organize and critically apply the concepts and methods of business analytics
6. Assess decision problems and build models for creating solutions using business analytical tools.

UNIT- I
Business analytics: Overview of Business analytics - Scope of Business analytics - Business Analytics Process - Relationship of Business Analytics Process and organisation - competitive advantages of Business Analytics - Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT- II
Trendiness and Regression Analysis: Modelling Relationships and Trends in Data - simple Linear Regression - Important Resources - Business Analytics Personnel - Data and models

for Business analytics - problem solving - Visualizing and Exploring Data, Business Analytics Technology.

UNIT- III

Organization Structures of Business analytics: Team management - Management Issues - Designing Information Policy – Outsourcing - Ensuring Data Quality - Measuring contribution of Business analytics - Managing Changes - Descriptive Analytics - predictive analytics - predicative Modelling - Predictive analytics analysis - Data Mining - Data Mining Methodologies - Prescriptive analytics and its step in the business analytics Process - Prescriptive Modelling - nonlinear Optimization.

UNIT- IV

Forecasting Techniques: Qualitative and Judgmental Forecasting - Statistical Forecasting Models - Forecasting Models for Stationary Time Series - Forecasting Models for Time Series with a Linear Trend - Forecasting Time Series with Seasonality - Regression Forecasting with Casual Variables - Selecting Appropriate Forecasting Models - Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform - New-Product Development Model - Newsvendor Model - Overbooking Model - Cash Budget Model.

UNIT- V

Decision Analysis: Formulating Decision Problems - Decision Strategies with the Outcome Probabilities - Decision Trees - The Value of Information - Utility and Decision Making - Recent Trends in Embedded and collaborative business intelligence - Visual data recovery - Data Storytelling and Data journalism.

TEXT BOOKS

1. S. Christian Albright & Wayne Winston, *Business Analytics: Data analysis & Decision making*, 6th Edition, Cengage Learning, 2019
2. James Evans, *Business Analytics*, 2nd Edition, Pearson Education, 2013.

REFERENCES

1. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, *Business analytics Principles, Concepts, and Applications*,1st Edition, Pearson FT Press, 2014.

2. Seema Acharya & RN Prasad, *Fundamentals of Business Analytics*, 2nd Edition, WILEY

3. Galit Shmueli, Peter C. Bruce, Nitin R. Patel, *Data mining for business analytics: Concepts, Techniques and Applications in Microsoft Office Excel with XLMiner*, WILEY, 2008.

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(19CE1028) COST MANAGEMENT OF ENGINEERING PROJECTS

(Open Elective)

COURSE OBJECTIVES

The objectives of this course:

1. *Establish systems to help streamline the transactions between corporate support departments and the operating units.*
2. *Devise transfer pricing systems to coordinate the buyer-supplier interactions between decentralized organizational operating units.*
3. *Use pseudo profit centres to create profit maximizing behaviour in what were formerly cost centres.*

COURSE OUTCOMES (COs)

On successful Completion of this course, the student will be able to

1. *Summarise the concept of strategic cost management, strategic cost analysis – target costing, life cycle costing and Kaizen costing and the cost drive concept.*
2. *Describe the decision-making; relevant cost, differential cost, incremental cost and opportunity cost, objectives of a costing system.*
3. *Summarise the meaning and different types of project management and project execution, detailed engineering activities.*
4. *Understand the project contracts,*
5. *Describe the cost behaviour and profit planning types and contents, Bar charts and Network diagram.*
6. *Analyse by using quantitative techniques for cost management like PERT/CPM.*

UNIT – I

Introduction and Overview of the Strategic Cost Management Process.

UNIT-II

Cost Concepts: Cost concepts in decision-making - Relevant cost - Differential cost - Incremental cost and Opportunity cost - Objectives of a Costing System - Inventory valuation - Creation of a Database for operational control - Provision of data for Decision Making.

Unit – III

Project Management: Project: meaning - Different types - why to manage - cost overruns centers - various stages of project execution: conception to commissioning - Project execution as conglomeration of technical and nontechnical activities - Detailed Engineering activities - Pre project execution main clearances and documents - Project team: Role of each member - Importance Project site: Data required with significance - Project contracts - Types and contents - Project execution Project cost control - Bar charts and Network diagram - Project commissioning: mechanical and process.

UNIT – IV

Cost Behavior and Profit Planning: Cost Behavior and Profit Planning Marginal Costing - Distinction between Marginal Costing and Absorption Costing - Break-even Analysis - Cost-Volume-Profit Analysis - Various decision-making problems - Standard Costing and Variance Analysis - Pricing strategies: Pareto Analysis - Target costing - Life Cycle Costing - Costing of service sector - Just-in-time approach - Material Requirement – Planning - Enterprise Resource Planning -Total Quality Management and Theory of constraints - Activity-Based Cost Management - Bench Marking - Balanced Score Card and Value-Chain Analysis - Budgetary Control - Flexible Budgets - Performance budgets - Zero-based budgets - Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT-V

Quantitative Techniques: Quantitative techniques for cost management - Linear Programming, PERT/CPM - Transportation Problems - Assignment problems – Simulation - Learning Curve Theory.

TEXT BOOKS

1. Robert S Kaplan Anthony A. Alkinson, *Management & Cost Accounting.*
2. N.D. Vohra, *Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.*

REFERENCES

1. *Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi*.
2. Charles T. Horngren and George Foster *Advanced Management Accounting.*
3. Ashish K. Bhattacharya, *Principles & Practices of Cost Accounting A. H. Wheeler publisher*.

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(19EE2128) WASTE TO ENERGY

(Open Elective)

COURSE OBJECTIVES

The objectives of this course:

1. *To learn different types of waste materials available for energy conversion*
2. *To understand Pyrolytic oil and gases*
3. *To introduce gasification methods for biomass*
4. *To learn concepts of biomass resources, combustion types and biogas plant technology*

COURSE OUTCOMES (COs)

On successful completion of this course, the student will be able to

1. *Analyse agro based, forest residue and industrial waste conversion processes.*
2. *Manufacture of Pyrolytic oils and gases*
3. *Manufacture of charcoal, yields and applications*
4. *Understand various types of gasifiers operation*
5. *Understand inclined and fluidized bed combustors operation*
6. *Understand types of biogas plants and biomass energy programme in India*

UNIT- I

Introduction to Energy from waste: Classification of waste as fuel –Agro based- Forest residue- Industrial waste- MSW- conversion devices- Incinerators- Gasifiers-Digestors.

UNIT- II

Bio-mass Pyrolysis: Pyrolysis- Types- Slow-Fast- Manufacture of Charcoal- methods- yields and application. Manufacture of Pyrolytic oils and gases – yields and applications.

UNIT- III

Biomass Gasification: Gasifiers- Fixed bed system- Downdraft and Updraft gasifiers- Fluidized bed gasifiers- construction and operation- Gasifier burner arrangement for thermal heating.

UNIT- IV

Biomass Combustion: Biomass stoves- Types- Inclined combustors- Fluidized bed combustors- construction and operation of above biomass combustors.

UNIT- V

Properties of Biogas: Biogas plant Technology and status – Biomass resources and their classification- Biomass conversion processes- thermo chemical conversion –Direct Combustion- Biomass gasification- Pyrolysis and liquefaction – bio-chemical conversion- anaerobic digestion- Types of biogas plants- applications-Biomass Energy Programme in India.

TEXT BOOKS

1. Non-Conventional Energy- Desai Ashok V. Wiley Eastern Ltd 1990.
2. Biogas Technology – A Practical Hand Book – Khandelwal K.C. and Mahdi SS, Vol I &II. Tata Mc Graw Hill Publishing Co Ltd.,1983.

REFERENCES

1. Food, Feed and Fuel from Biomass – Challal D.S., IBH Publishing Co Pvt Ltd.,1991.
2. Non-conventional Energy Sourcrs- GD Roy, Khanna Publishers, 6th Edition
3. Biomass & Bioenergy – Khahid Rehman Hekeem, Mohammad Jawald., Umar Rashid- Springer International Publishing Ltd.

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II M.Tech - I Sem.	**L**	**T**	**P**	**C**
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(19ME3121) INDUSTRIAL SAFETY
(Open Elective)

COURSE OBJECTIVES
The objectives of this course:

1. *To learn about mechanical and electrical hazards.*
2. *To learn about Fundamentals of Maintenance Engineering.*
3. *To learn about Wear and Corrosion and their prevention.*
4. *To know about Fault Tracking*
5. *To learn about Periodic and preventive maintenance.*

COURSE OUTCOMES (COs)
On successful completion of this course, the student will be able to

1. *Explain the Points of factories act 1948 for health and safety.*
2. *Define the term Cost & its relation with replacement economy.*
3. Recognize the Concept of Wear, Corrosion and its Prevention methods
4. Understand the Concept of sequence of fault finding activities and the importance of decision tree
5. *Elaborate the importance of scheduled preventive maintenance of mechanical and electrical equipment.*
6. *Distinguish between Periodic and Preventive maintenance of equipments.*

UNIT-I
Industrial Safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and fire fighting, equipment and methods.

UNIT-II
Fundamentals of Maintenance Engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT-III

Wear and Corrosion and their Prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT-IV

Fault Tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT-V

Periodic and Preventive Maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TEXT BOOKS

1. Higgins & Morrow, *Maintenance Engineering Handbook*, Da Information Services.
2. H. P. Garg, *Maintenance Engineering*, S. Chand and Company.

REFERENCE BOOKS

1. Audels, *Pump-hydraulic Compressors*, Mc graw Hill Publication.
2. Winterkorn, *Foundation Engineering Handbook*, Chapman& Hall London.

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(19ME3021) ADVANCES IN OPERATIONS RESEARCH
(Open Elective)

COURSE OBJECTIVES
The objectives of this course:

1. *Enumerate the fundamentals of Linear Programming*
2. *Learn classical optimization techniques*
3. *Develop the best strategy of Game and identifying the Queuing theory.*
4. *Understand about sequence and optimum Duration of the Project*
5. *Develop the importance of Replacement models and Inventory control*

COURSE OUTCOMES (COs)
On successful Completion of this course the student will be able to

1. *Create mathematical models of the real time situations.*
2. *Implement Transportation and Assignment problems to solve in real time industry*
3. C*hoose the best strategy of Game and capable of identifying the suitable queuing theory*
4. *Enumerate fundamental techniques and apply it to solve various optimization areas*
5. *Investigate, study, Apply knowledge in Replacement models and*
6. *Understand the Inventory control Models*

UNIT-I
Introduction to OR and Linear Programming-OR definition–Types of Operations Research models; Linear Programming- Problem Formulation, Graphical Method, Simplex Method, Big-M Method, Degeneracy - Problems

UNIT-II
Transportation Problem – Formulation; Initial Basic Feasible Solution-North-West Corner Rule, Least Cost Method, Vogel‘s Approximation Method, Modified Distribution (MODI) Method, Unbalanced Transportation - Problems
Assignment Problem – Formulation, Optimal Solution -Traveling Salesman problem.

UNIT-III
Game Theory - Introduction – Minimax (Maxi mini) Criterion and Optimal Strategy, Saddle Point, Solution of Games with Pure Strategy and Mixed Strategies – 2 X 2 Games – Dominance Principle.
Queuing Theory- Introduction to queuing system–Service Channel, Arrival Pattern, Size of Population, Service Pattern, Queue Discipline, Customer Behavior, Probability Distribution-Birth & Death Process, Simple Problems on Single Service channel only.

UNIT-IV

Sequencing –Terminology - Johnson's Algorithm for n-jobs x 2 Machines and n-jobs x 3 machines models - Problems

PERT & CPM: Introduction, Difference between PERT and CPM, Terminology- Activities, Events, Predecessor, Early Start, Early Finish, Late Start & Late Finish Times, Earliest Occurrence and Latest Occurrence of the Event, Total Float, Free Float, Independent Float; CPM- Deterministic Model; PERT- Probabilistic Model, Critical Path, Optimal Project Duration, Least Possible Project Duration- Problems.

UNIT-V

Replacement – Failure Mechanism of Items**,** Types of Replacements- Individual Replacement policy, Group Replacement policy, Replacement of items fail suddenly – problems

Inventory - Necessity for maintaining inventory, inventory costs, classification of fixed order quantity inventory models, selective inventory management techniques.

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TEXT BOOKS

1. S D. SHARMA, *Operations Research*,KNRN Publications, 17th edition 2015
2. Hamdy A Taha , *Operations Research*,Pearson Publications, 9th edition 2015

REFERENCES

1. Manohar Mahajan, *Operations Research*, Dhanpat Rai &Co 2016
2. Er. Premkumar Guptha & Dr.D.S.Hira, *Operations Research*, Schand publications 2012.
3. R Panneerselvam, *Operations Research*, PHI, 2nd edition, 2012

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(19ME3022) COMPOSITE MATERIALS
(Open Elective)

COURSE OBJECTIVES
The objectives of this course:

1. *To understand the mechanical behavior of composite materials*
2. *To get an overview of the methods of manufacturing composite materials.*
3. *To know the fundamentals of composite materials.*
4. *To understand the fabrication and process of composites.*
5. *To recognize the applications of composite materials.*

COURSE OUTCOMES (COs)
On successful completion of this course, the student will be able to

1. *Explain the Fundamental concept of composite materials.*
2. *Classify different types of composite materials.*
3. *Describe the Fabrication and processing of composite materials.*
4. *Illustrate the Methods of preparation of Metal matrix Composites and polymer matrix composites*
5. *Discuss about the Mechanical behavior of composite materials.*
6. *Explain the application of composite materials.*

UNIT-I
Introduction To Composites: Fundamentals of composites – need– enhancement of properties – classifications —Introduction to Reinforcement composites–types. Applications.Fiber production techniques for glass, carbon and ceramic fibers –Resin materials-Types.

UNIT-II
Polymer Matrix Composites: Fabrication of PMC's ,Fabrication of Fibers, Plastic Fiber Forms, Pre-pregs, Molding Compounds-Processes, Lay-Ups, Filament Winding, Pultrusion, and Recycling. Matrix – Reinforcement Interface, Wettability.

UNIT-III
MMC & CMC : Fabrication of MMC'S, Liquid Infiltration- Casting, Solid State Processes-Diffusion Bonding &In Situ Technique. Fabrication of CMC's, Hot-Pressing, Infiltration, In Situ Chemical reaction Techniques. CVD& CVI, Sol-gel.

UNIT-IV
Mechanics of Composites: Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of

lamina properties, determination of lamina stresses, maximum stress and strain criteria, Von - Mises Yield criterion for isotropic materials, generalized Hill's criterion for anisotropic materials, Tsai-Hill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates

UNIT-V

Applications Of Composites: Applications of advanced composite materials. Environmental effects in Composites, Green composites, Synthesis and Properties of Nano composites. Surface Composites & Surface metal matrix composites: Need, Synthesis, Properties and applications.

TEXT BOOKS

1. Mathews F. L. and Rawlings R. D., *Composite Materials: Engineering and Science*, 1st Edition, Chapman and Hall, London, England, 1994.
2. Chawla K. K., *Composite materials*, Second Edition, Springer – Verlag, 1998.

REFERENCES

1. Clyne, T. W. and Withers, P. J., *Introduction to Metal Matrix Composites*, Cambridge University Press, 1993.
2. Strong, A.B., *Fundamentals of Composite Manufacturing*, SME, 1989.
3. Sharma, S.C., *Composite materials*, Narosa Publications, 2000.